

**THE IMPLEMENTATION OF WASTE MANAGEMENT SYSTEM
IN “EGNATIA ODOS” MOTORWAY**

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Abstract

Sharing the global concern on issues pertaining to the environmental degradation, the company “EGNATIA ODOS AE” applies a system of environmental management, that is, a method of organising and implementing environmental protection measures in the design, construction, operation and maintenance stages of the project. The company also puts a lot of effort in keeping a balance between its technical and economical activities, and their impact on the environment, being aware that development cannot be achieved without ensuring the protection of natural resources. Aiming at sustainable

development, “EGNATIA ODOS AE” introduces a new perception and an innovative environmental management strategy during the operation and maintenance of the motorway protecting both the natural and the human environment. Among others, the company aims at the effective management of the produced waste. The management of waste constitutes one of the most complex and difficult environmental issues countries are facing. Millions of tons of waste are produced on a daily basis, and this can result in the degradation of the environment and the quality of every-day life, as well as in various health problems. Along the Egnatia Motorway, an efficient waste management program is implemented aiming in reducing the generated waste, increasing the reuse and recycle of waste materials and therefore protect the environment. Large amounts of waste materials such as paper, glass, aluminium/scrap, plastic, metal, oils, tyres, wood, aggregates, electric equipment and others are treated annually in a most effective way.

Key words: waste management, environmental monitoring, hazardous and non-hazardous waste.

1. Introduction

Egnatia Odos S.A. is the company responsible for the design, construction, operation, maintenance and exploitation of the Egnatia Motorway. Egnatia Odos S.A. also manages the design and construction of additional projects and has extended its

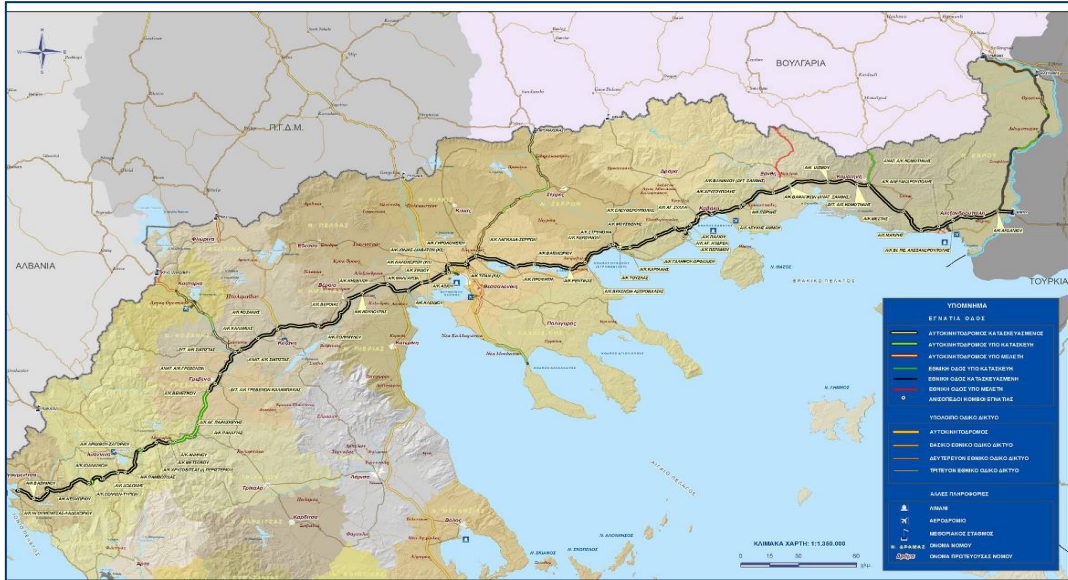
activities abroad, by participating in international tenders and undertaking contracts for the management and supervision of designs and construction works, mainly of large infrastructure projects. Additionally, the company undertakes programmes under the European Territorial Cooperation INTERREG, and other European Funding programmes (i.e. FP7, HORIZON 2020) aiming at cross-border, transnational and interregional co-operations in areas such as mobility, management, environment, etc.

Egnatia Odos S.A. aims at designing, constructing, and operating the motorway by applying innovations in the management and administration of public works projects, while at the same time is making an effort to minimise or even prevent the impact on the environment. For this reason the company introduces an environmental strategy and a new perception of highway construction, maintenance and operation and also protection of the natural and manmade environments, by investing on environmental purposes a significant percentage of the total budget. The company's complete and efficient environmental strategy respects the national resources, implements advanced technologies and is based on the Greek and European Community legislations on environmental protection, the international standards, and the principles of sustainable development.

1.1 The project's identity

The Egnatia Motorway constitutes one of the priority projects of the Trans-European Transport Network and is the communication link spanning Northern Greece from its western to its eastern border. The Egnatia Motorway crosses the Greek regions of Epirus, Macedonia and Thrace starting from the port of Igoumenitsa, the starting point of the ferries connecting Greece with Italy, and ending to Kipoi in Evros (Greek-Turkish borders). Being a collector axis of the Pan-European Corridors leading from North to South, it is of great geostrategic importance for both the Balkans and South-Eastern Europe. It is concerned as a collector route for the Balkan and South-eastern European transport system. Pan-European Corridors IV (Berlin-Sofia-Thessaloniki), IX (Helsinki-Alexandroupolis) and X (Vienna-Belgrade-Thessaloniki) all end at the Egnatia Motorway. On a national level, the Egnatia Motorway increases investments in sectors like transport, industry and tourism, and it plays an important role as a major development axis in Northern Greece.

The axis of Egnatia motorway is presented in photograph 1 below and has the following main characteristics presented in Tables 1 & 2:



Photograph 1. Egnatia Odos Motorway

Table 1. Main characteristics of Egnatia Odos motorway (a)

•	50 road interchanges
•	350 entrance / exit over bridges and underpasses
•	1650 major bridges, with a total length of nearly 40 km, and many small ones
•	76 tunnels up to 4,8km long, with a total length of nearly 49,5km (or 99km measured as single-carriageway ones)
•	43 river crossings
•	11 railway crossings

Table 2. Main characteristics of Egnatia Odos motorway (b)

STRETCHING:	From Igoumenitsa to Kipi (Evros)
PROJECT SIZE:	670 kilometres
SERVING THE REGIONS OF:	Thesprotia - Ioannina - Grevena - Kozani - Imathia - Thessaloniki - Kavala - Xanthi - Rodopi – Evros
LINKED WITH THE BORDERS OF:	Albania - FYROM - Bulgaria - Turkey, through nine major vertical axes
PASSING THROUGH THE TOWNS OF:	Igoumenitsa - Ioannina - Metsovo - Grevena - Kozani - Veria - Thessaloniki - Kavala - Xanthi - Komotini – Alexandroupoli
LINKED TO THE PORTS OF:	Igoumenitsa - Thessaloniki - Kavala - Alexandroupoli
AND THE AIRPORTS OF:	Ioannina - Kastoria - Kozani - Thessaloniki - Kavala – Alexandroupoli 332 towns and villages
PASSING NEAR:	30 regions of particular interest
SERVING THE INDUSTRIAL ZONES OF:	Ioannina - Florina - Edessa - Thessaloniki - Kilkis - Serres - Drama - Xanthi - Komotini – Alexandroupolis, either directly or through its vertical axes
PROPOSING AND FINANCING:	Archaeological excavations, protection of monuments, environmental protection works (biotopes, etc.)
TECHNICAL CHARACTERISTICS:	Dual carriageway of international standards with two traffic lanes per direction, a central reserve and an emergency lane.

The motorway impact zone corresponds to:

•	36% of the country's population.
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•	33% of the country's GNP.
•	54% of the country's agricultural land and 65% of the total irrigated land, as far as the primary sector is concerned.
•	41% of the country's employment in industry-small trade, as far as the secondary sector is concerned.
•	51% of the country's extractive industry.

1.2 The environment surrounding the routing of Egnatia Odos motorway

The successive natural and manmade environments along the project are exceptionally diverse, both through the mountains of Pindos and Western Macedonia, and the plains of Central / Eastern Macedonia and Thrace.

The Egnatia Motorway runs through Greek mountainous and plain landscapes of exquisite beauty and ecological importance. Its alignment follows the Ancient Roman Via Egnatia. Along this ancient route, within an approx. 1000 meters zone, 270 sites of historical interest have been identified, while in its vicinity, significant archaeological sites and natural resources of critical importance are located (gold mines, deposits of various metals, wetlands, ground and surface waters, high capacity soils, etc). The Egnatia Motorway runs past Pindos and other Greek mountains and reveals a variety of exceptionally interesting geological formations, valleys and ravines.

Along the route of the highway one can find:

- 17 Natural Habitat Areas protected under the European "Natura 2000" Network

- 4 Wetlands protected under the Ramsar Convention
- 70 wildlife conservation areas (formerly wildlife reserves)
- 270 sites and monuments of historical interest
- Most of the longest rivers in Greece (Evros, Nestos, Strymonas, Gallikos, Axios, Aliakmonas, Venetikos, Metsovitikos, Arachthos, etc).

1.3 Actions taken for environmental protection - The Environmental Management System in Egnatia Odos motorway

The Egnatia motorway is one of the first large-scale public works to apply a system of environmental management, that is, a method of organising and implementing environmental protection and mitigation measures in the design, construction, maintenance and operation stages of the project. This covers heritage protection, impacts on ecosystems, noise, waste, energy, cleaning / maintenance / restoration, pollutant gases and water.

The actions taken for the protection of the environment are the following:

- The Egnatia Motorway alignment follows the traces of the ancient Via Egnatia. Along its route and within a 1000m wide zone, 270 sites of historical interest have been identified. Egnatia Odos S.A. proceeded to actions aiming at the protection and preservation of the **cultural heritage** of Greece, as well as at its enhancement, when this was feasible.

- Egnatia Odos S.A. supports actions jointly undertaken by the company, **environmental organizations and specialized scientists** for the monitoring and assessment of the motorway impact on ecosystems and fauna during construction and operation.
- Egnatia Odos S.A. aims to minimize the noise disturbance caused by the motorway's operation. To this effect, a **monitoring program of the Road Traffic Noise** is set up in residential districts.
- Egnatia Odos S.A. runs programs for **monitoring the concentration of pollutant gases** in certain areas along the motorway axis. Air quality management is one of the company's main targets, connected with the life quality of the inhabitants of adjacent to Egnatia Motorway settlements and also with the policy against global heating.
- Egnatia Odos S.A., in order to protect surface and ground waters runs a program for the **monitoring and assessment of the motorway's run-off waters** quality at the points of discharge to the adjacent receivers (i.e. rivers, lakes).
- Egnatia Odos S.A., using skilled staff, **gathers any kind of waste** from the road's surface. The company applies a waste management program based on the existing environmental legislation.
- Egnatia Odos S.A. takes certain actions in order to **limit energy consumption and use of renewable energy resources**.

1.4 Waste Management in Egnatia Odos motorway

The management of waste constitutes one of the most complex and difficult environmental issues our country, as well as all modern societies, is called to address, an issue requiring direct and environmentally sound solutions. In recent years the expansion of large cities, the continuous growth of tourist flow, the rise in living standards and the subsequent change of consumption patterns have led to a significant increase on the amount of waste and to the limitation of appropriate disposal areas. Moreover, the composition of waste has changed in recent years (increase of hazardous and toxic waste, development of complex packaging material, etc). Modern cities, big businesses, industries, hospitals and modern motorways can be considered harmful to the environment due to the amount of waste produced, which constantly increases as mentioned above. Millions of tons of waste are produced on a daily basis and that leads to the occurrence of manifold problems, such as the pollution and contamination of the soil and groundwater, unpleasant odour and views, dispersal of small objects, and spontaneous combustion of waste that raises the risk of fires. Such problems result in the degradation of the environment and the quality of every-day life, as well as in various health problems.

Modern concepts and practices for the management of waste require longer planning as well as the implementation of integrated systems, with key objectives being sustainability and effective management. Large amounts of useful materials such as

paper, glass, aluminium/scrap, plastic, metal, wood can either be reused or recycled, saving huge amounts of raw materials and energy. In fact, landfills should be designated for the disposal of residues occurring after the treatment/recycling of waste.

Along the Egnatia Motorway, the collection of waste found on the pavement, the central reserves, the slopes and the roadside facilities is performed on an every-day basis. Most of this waste consists of: packaging waste – plastic waste – dead animals – organic waste – electrical waste – mineral oils. Due to its size, the company considered it necessary to implement an integrated program for the management of the produced waste pursuant to the standing legislation and with the aim to reduce the motorway pollution.

2. Materials and Methods

The main axis of Egnatia Motorway, has a total length of 670 kilometers, and passes through five (5) Regions: Epirus, Thessaly, Western Macedonia, Central Macedonia and Eastern Macedonia and Thrace. In addition Egnatia Odos S.A. is responsible for the maintenance and operation of several vertical axes which raise significantly the length of the motorway.

The total motorway is divided into four areas in order to achieve the most efficient way of management in all of the above mileage. Four district offices are responsible for the maintenance and operation of the road, situated in those areas : the Regional Office

of Ioannina, the Regional Office of Grevena, the Regional Office of Thessaloniki and the Regional Office of Komotini.

For implementing an effective waste management system the company created an integrated management program based on the waste collected from the motorway and its facilities. Specialized waste management companies are responsible for the provision and placement of the waste bins at the appropriate areas, for emptying them at regular intervals, for transporting the waste to their premises, sorting it, disposing recyclable materials at the corresponding recycling companies and disposing the rest at legally licensed areas. These companies provide waste management certificates and deliver reports as well as statistical data on the recyclable materials and the quantities of waste ending up in the disposal areas.

The management and final disposal is done on the basis of the approved environmental terms and the existing legislation on waste management and disposal. The main components of those collected waste are mainly: Metal/Alluminium/Scrap, Paper, Plastic, Glass, Wood, Mixed Waste, Tyres, Oils, Organic waste, Electrical and electronic equipment.

Regarding the hazardous waste, treatment plants, called Pollution Control Units (PCUs) were constructed along the axis of Egnatia Odos motorway. Their construction fulfilled the existing Environmental Terms, according to which, it is necessary to take measures to prevent pollution of water and other sensitive areas along the alignment of

the motorway. Since 2006, one hundred (100) PCUs have been constructed throughout the motorway, especially in areas that are adjacent to rivers, streams and lakes considered as sensitive ecosystems. Those units treat in an efficient way the pollutants carried by runoff of surface water during rainfalls and additionally they collect and isolate waste leaks after accidents in the motorway. These special units demand regular monitoring, maintenance, cleaning and management of the hazardous waste collected. The operation and maintenance of the PCUs is of great importance, it is considered as an essential parameter for environmental protection along the motorway and should deal with specific health and safety risks, such as confined spaces, toxicity, slips, trips and falls, manual handling, weather, transport of hazardous waste. These tasks have been assigned to a specialized hazardous waste management company contracted with “EGNATIA ODOS SA”.

Furthermore, the company is responsible for the management of old, destroyed, surplus or useless material used along the motorway or at its various construction sites, materials that need to be replaced after having been worn and torn or damaged. Such materials consist of:

- Metal/Aluminum/Scrap
- Waste electrical and electronic equipment (WEEE),
- Waste batteries and accumulators

Egnatia Odos SA cooperates with licensed Waste Management Systems (EMS) responsible for the management of the relevant waste. The waste are delivered to waste recycling centres or to authorised treatment facilities where they are weighed and categorized in accordance with the relevant directives and laws.

Based on all these activities, the Environment Department of the Operation, Exploitation and Maintenance Division of the “EGNATIA ODOS SA” gathers and enters all relevant data into a specially designed database, and then dispatches the resulting summary reports to the Ministry for the Environment, Energy and Climatic Change. Furthermore the company uses an information system (Routine Maintenance Management System - RMMS) for the effective management of the routine maintenance of the motorway, including the collection of non hazardous waste. By this information system the control of works is achieved as well as the quality and effectiveness of the maintenance services.

3. Results and Discussion

Based on the available data up to date, after the implementation of the waste management program, the following statistics on the quantities of waste collected per Regional Office were revealed:

(1) In the area of responsibility of the Regional Office of Thessaloniki where there is the highest Annual Average Daily Traffic (AADT), the amount of waste collected under the program are 4.5 Tn per month in average. The percentages by category of waste are 30% tyres, 26% plastic, 10% metal/scrap, 7% wood, 6% paper, and 21% others (Fig.1) . The disposal is performed as follows : the recyclable materials are delivered to the Recycling Sorting Centre of Tagarades area and the others are placed in Mavrorachi Landfill.

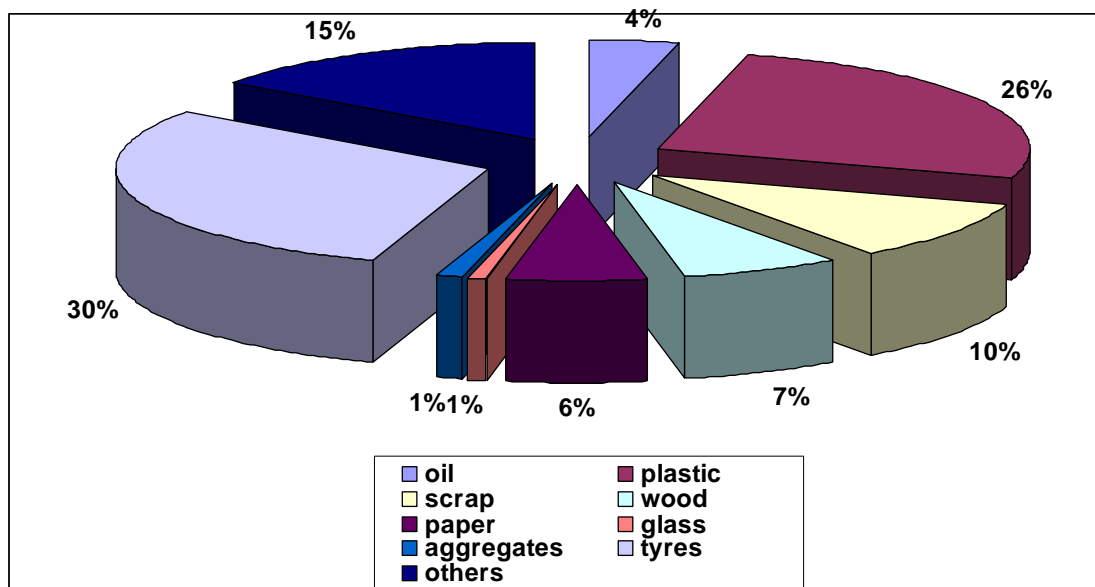


Figure 1. Waste collected in the area of Thessaloniki Regional Office

(2) In the area of responsibility of the Regional Office of Ioannina where the Annual Average Daily Traffic (AADT) is not highly significant, the amount of waste collected under the program are 1.2 Tn per month in average . The percentages by category of

waste are 30% Plastic , 17% Metal/Scrap, 10% tyres, 7% wood, 6% paper and 29% others . The disposal is performed as follows : the recyclable materials are delivered to the Recycling Sorting Centre of Ioannina and the others are placed in the Landfills in Ipeirus area.

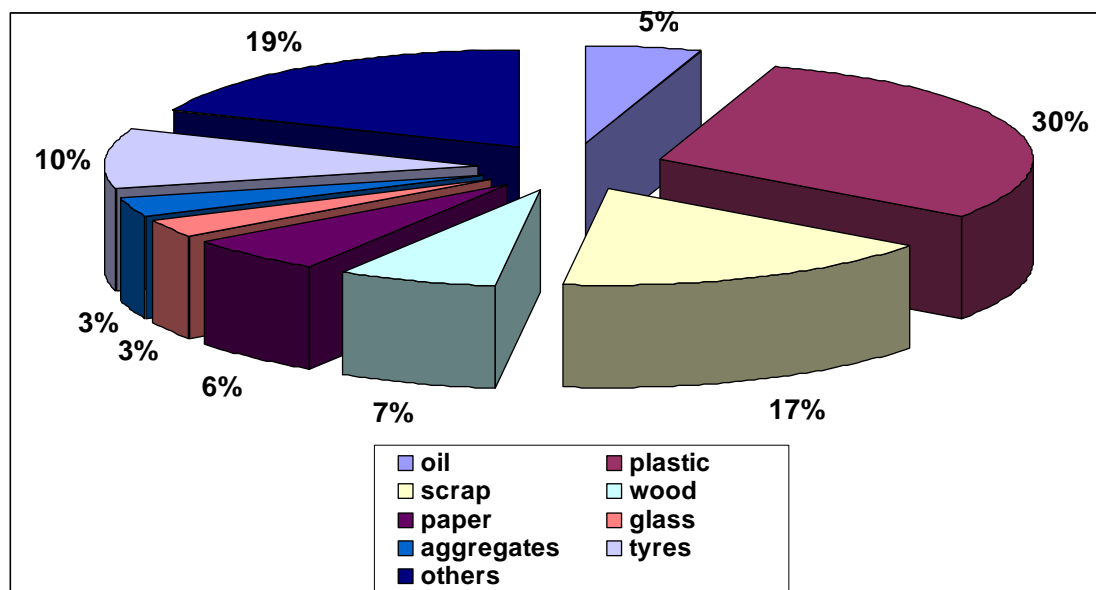


Figure 2. Waste collected in the area of Ioannina Regional Office

(3) In the area of responsibility of the Regional Office of Grevena the amount of waste collected under the program are approximately 3 Tn per month. Egnatia Odos S.A, is in co-operation with DIADYMA company which is responsible for the management of waste in Western Macedonia. The waste are transfered to the waste transhipment Stations of Kozani, Grevena and Siatista where the recyclable materials are sorted and the rest are placed in the Landfill of the mines area (Agios Dimitrios).

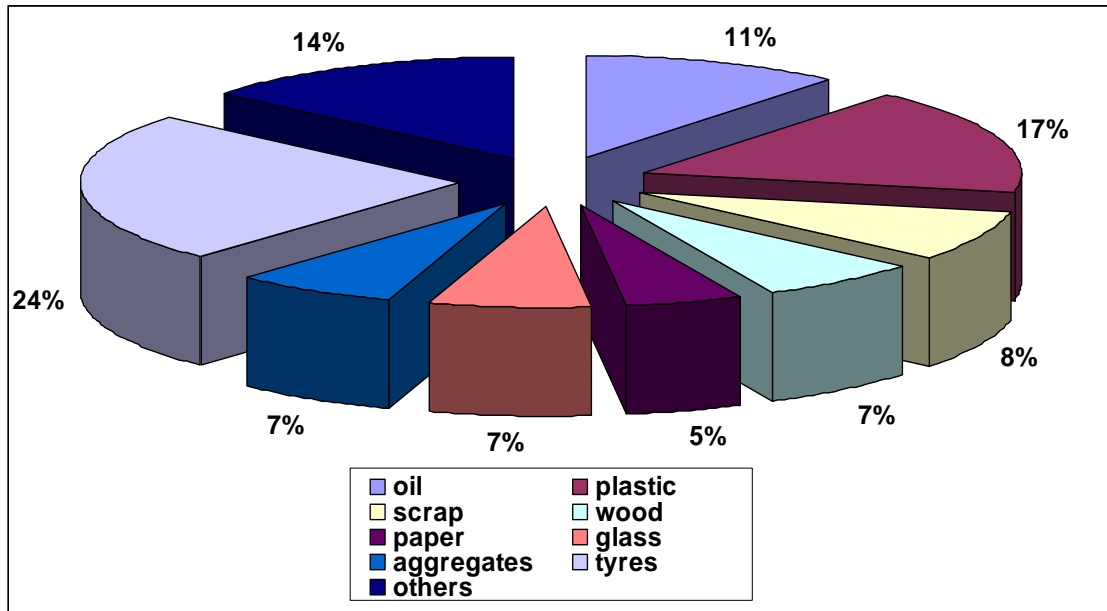


Figure 3. Waste collected in the area of Grevena Regional Office

(4) In the area of responsibility of the Regional Office of Komotini, where the Annual Average Daily Traffic (AADT) is the lowest, the amount of waste collected under the program are approximately 1 Tn per month. Egnatia Odos S.A. is in co-operation with the municipalities of Kavala, Komotini and Alexandroupolis and the total amount of waste is disposed in waste disposal areas legally licenced.

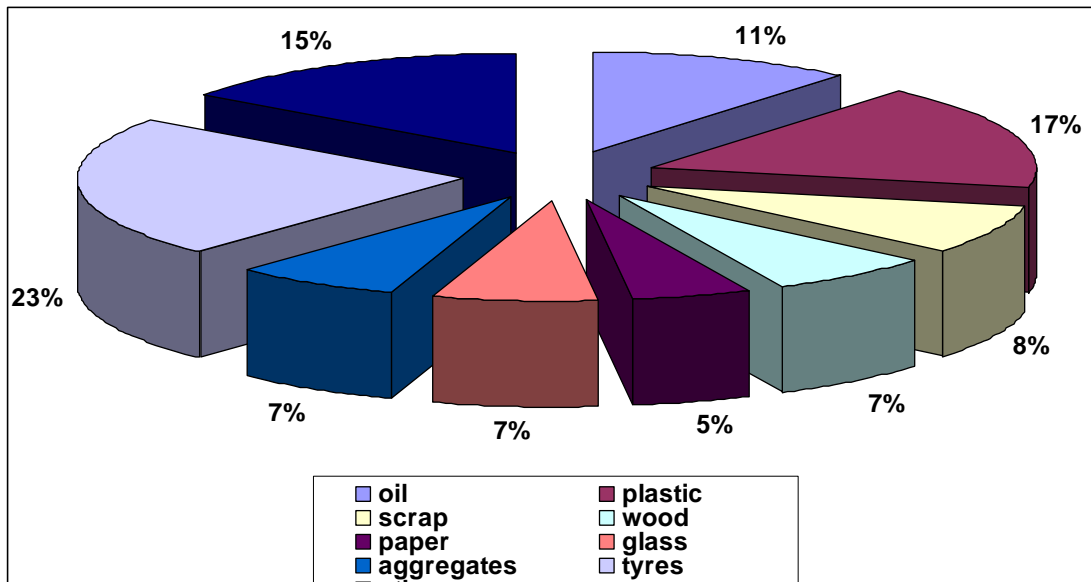


Figure 4. Waste collected in the area of Komotini Regional Office

3.1 *Electrical and electronic Waste*

From December 2012 a total amount of 23.081 kg of electric and electronic waste has been gathered from areas of Egnatia motorway in Thessaloniki, Ioannina, Grevena, Kozani, Kavala, Komotini and Alexandroupoli. An amount of 3.540 kg were fluorescent tubes and other mercury-containing waste, and an amount of 19.020 kg were discarded electrical and electronic equipment containing hazardous components. Furthermore 31 kg of lead batteries and 490 kg of mixed batteries and accumulators were collected. The waste are delivered to waste recycling centres or to authorised treatment facilities

3.2 *Hazardous Waste*

According to the legislation and the classification of waste into categories according to the European Waste List (Decision 2001/118/EC), waste collected from the Pollution Control Units can be classified either code under code 130 508* (mixtures of wastes from wards residues and oil/water separators), code 160 708* (waste containing oil) or code 130502* (separator sludges from oil/water).

The amounts collected approximately per year are 500 tonnes of liquid waste and 3 tonnes of sludge.

The liquid hazardous waste collected from the Pollution Control Units are transferred with storage tanks at the port of Thessaloniki via Egnatia motorway and other national roads, according to the predictions of the ADR agreement (i.e. speed restriction, transfer during non-rush hours, emergency response guide, ADR driving licences, vehicle signage, ADR security consultant, ect.). The transfer of waste from the tanks to the final recipient is made by tankers in accordance with the requirements of the IMDG Code and International maritime safety regulations. The necessary forms of identification of hazardous waste are completed and signed during the transportation.

The sludge collected from the PCU's is stored into metal drums (UN certified) which are transferred in Thessaloniki by closed vans according to ADR agreement. The amount of waste is delivered to the final recipient (companies certified for the management of hazardous waste).

4. Conclusions

Egnatia Odos S.A. introduces a different approach and a new strategy in the operation and maintenance of major road axes in Greece, by implementing the preservation and protection of the natural and man-made environment. The management of waste is considered of great importance because it is essential for the environmental protection during the maintenance and operation of a project. Nowadays, more than ever it constitutes a significant factor equally important to the technical and financial factors. These three factors should be involved in the process, in such a way so as to result in a technically complete and environmentally acceptable project.

Egnatia Odos S.A. adopts the national and european policy regarding waste management and takes measures to prevent the generation of waste and to promote reuse, recycling and other forms of recovery in order to reduce the quantity of such waste, whilst also improving its environmental performance.